RESPONSE OF ALKALI TREATED RICE HUSK IN BUFFALO CALVES ON GROWTH, DRY MATTER INTAKE, NUTRIENT DIGESTIBILITY and BLOOD METABOLITES.

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ABSTRACT: A feeding plan was undertaken in Nili-Ravi growing male buffalo calves having age of 6-8 months and 100-120 Kg live body weight to observe the effect of 2% alkali treated rice husk contained in the diet on feed and growth performance. Rice husk was treated with 2% NaOH solution (50 % water to substrate; weight/volume). Four different types of TMRs (1.2.3.4) were formulated and TMR-1 served as control ration containing untreated 30% rice husk and TMRs-2,3,4 were test rations and contained 10%,20%,and 30% alkali treated rice husk. Calves were divided into four groups (n=5) and were allotted the diet randomly and stall feeding was practiced. Weighed quantity of each TMR was offered daily and refusal was recorded after twenty four hours to calculate the actual quantity of feed intake by the animals daily. In addition, 2 Kg of green fodder was also provided. The trial lasted for 90 days along with 10 days as feed adjustment period. At end, a digestibility trial was conducted on three animals of each group for three days. Blood samples were taken for BUN and blood glucose post feeding two times during the trial. Statistically there was non-significant difference on growth performance and feed efficiency in the animals of all groups. Digestibility of Dry Matter, CP, EE, Ash and OM also revealed non-significant difference. Mean values of blood metabolites were apparently higher in control group but statistically difference was non-significant. Results revealed some improvement on growth, FCR, Nutrient Digestibility in animals fed on treated rice husk based diet. Economically rice husk can be used in the formulation of diet for finishing the animals up to 30% safely and without any hazard.

Key words: Nili-Ravi Calves, Alkali treated rice husk, Growth Performance, Digestibility, Blood metabolites.

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INTRODUCTION

Pakistan is an agriculture country and its economy is mainly based on agriculture and livestock production. The livestock density of Pakistan is well tolerant to hot and humid conditions and efficiently converts of low grade roughages into high profile livestock products (Younas and Yaqoob, 2005). Green and dry roughages form the most important livestock feed in the country. The dry roughages are comparatively much cheaper as compared to green fodders and are usually the cereal crops residues in the form of straws, stover and husk. The present forage production is not coping with the feeding requirements of livestock in Pakistan. Average rice grain to rice straw ratio of rice field is 1 : 1.25 (Oladosu *et al.,* 2016). Pakistan is deficient by 40% in forages and 80% in concentrate feed (Pasha, 1998). Stresses for the exploitation of new feed resources and the interest for utilization of low quality crop residues (Rice husk and maize stover etc.) as an animal feed has been increased. These crop residues have poor nutritive value (low CP, high lignin content), characterized by poor digestibility and hence their intake is also low and energy is limited due to lignocellulosic bonds (Sarwar *et al*., 1994).

Rice is 2nd most cultivated cereal grain in Pakistan (PARC, 2018). Rice husk is a residual material produced during rice processing and husk is removed from other parts of the paddy grain. Traditionally, rice husk/rice hulls are being used as a component in cattle and poultry feeds in limited quantity due to low nutrients digestibility, high silica/ash content and coarse feeding characteristics (Naseer *et al*., 2017) Rice hulls contains lowest total digestible nutrients, among all cereal by-products (Sataar *et al.*,2015). High silica content, low ruminal degradation of carbohydrate and reduced nitrogen contents also affect the nutritional value of rice straw (Peripolli *et al.*, 2016). Chun-Yang Yin, (2011) reported that rice husk is composed of crude protein 5-6% fat, 8-12%, crude fibre 39-42% and minerals 12%. Rice husk is under utilized and highly available resource. Huge quantities of rice husk are being wasted or burnt causing polluting the environment (Kim *et al*., 2003).

Multiple previous studies have been undertaken on the physical and chemical description and consumption of rice straw and husk as cattle feed (Shen *et al*., 1998). At present, various methodologies on physical, chemical and biological treatments have been practiced in order to improve the consumption of rice straw by ruminants (Selim *et al*., 2004). Biochemical conversion of lignocellulosic biomass into value added products is a subject of great interest. To achieve this purpose, it is necessary to change the composition of cellulosic biomass so that enzymes can convert structural carbohydrates (cellulose) in to highly fermentable simple sugars (Mosier *et al*., 2005). Numerous chemical and biological treatments have altered the composition of biomass for the (enzymatic) breakdown of complex sugars (cellulose and hemicellulose) more rapidly.

The alkaline treatment causes the removal of lignin from the biomass and hence improving the reactivity of the remaining polysaccharides. In addition, alkali pre-treatments remove acetyl and the various uronic acid substitutions on hemicellulose that lower the accessibility of the enzyme to the hemicellulose and cellulose surface (Chang and Holtzapple, 2000). By using calcium hydroxide or sodium hydroxide, salts are formed that may be integrated in the biomass (González *et al*., 1986).

Keeping in view, all above narrated observations regarding the roughages, a study was planned to improve the nutritional worth as well as its keeping quality and their proper utilization in animal feed to sustain their production and to test the effect of varying level of treated rice husk in growing buffalo calves.

MATERIALS AND METHODS

Treatment of Rice Husk: Different concentrations of alkali treatment (2, 4 and 6%) at room temperature were applied, but laboratory results revealed 2% level of Alkali treatment safe and economical and this level was used in this pilot study. For this, 2% NaOH solution were prepared in water and sprinkled on rice husk in such a way that each particle of husk be wetted with NaOH solution at room temperature and treated rice husk was ready for analysis after 24 hours. The 2% concentration of NaOH was dissolved thoroughly in 50 liters water and sprinkled on 100 Kg rice husk.

Twenty male buffalo calves of similar age (6-8 months) were divided into 4 equal groups (five calves in each group) according to completely randomized design. Four TMR based diets with iso-caloric and iso-nitrogenous were formulated using NRC (2001) standards for energy and protein comprising 10, 20 and 30% treated rice husk (2% NaOH) while control group was fed diet containing 30% untreated rice husk (Table-2). Animals were weighed at start of the experiment and fortnight thereafter. The diets and animals were randomly allotted to each group. Experimental period was lasted for 100 days. First 10 days were given for nutritional acceptance and 90 days for sample recording. Feed offered and refusals were recorded on daily basis and thus dry matter intakes were computed. Weight gains were measured at fortnightly basis. During the last week of trial, a digestibility trial was conducted. All data obtained was analyzed statistically.

Table 1. Ingredient percentage and chemical composition of experimental diets.

Ingredients	**30%R.H. (Control)**	**20% Treated R.H.**	**10% Treated R.H.**	**30% Treated R.H.**
wheat Bran	4	12	24	4
Gluten 30%	20	20	20	20
Canola Meal	10	7.5	5	10
Cotton Seed Cake	4.5	4	4.5	4.5
Molasses	15	15	15	15
Mineral Mixture	1.5	1.5	1.5	1.5
Maize Grain	15	20	20	15
Rice Husk	30	20	10	30
TOTAL	**100**	**100**	**100**	**100**
Chemical Composition:-				
C.P %	14	14.13	14.41	14.11
M.E Mcal/Kg	2.44	2.56	2.65	2.44
TDN %	66.20	69.33	71.7	66.20
C.F %	14.38	11.40	9.03	14.25
Fat %	2.5	2.85	3.10	2.55
Ash %	9.03	8.10	7.37	9.03

Digestibility trial: At the end of performance study in growing calves, a digestibility trial was conducted by using three animals of each group. Data of daily TMR intake offered was recorded separately. This was done by

recording TMR (DM) offered and subtracting refusal from it. The feces were collected for 24 hours and kept separately for all 5 days of the digestibility trial period. The digestibility was calculated as follows;

$$\text{Digestibility (DM) \%} = 100 - \frac{\text{Total DM excreted during 24 hours}}{\text{Total diet DM (offered)} - \text{DM refused}} \times 100$$

Samples of feed offered and refusal were taken daily and composited at the termination of study. Diets, refusal and fecal samples were analyzed for Dry Matter, Crude Protein (AOAC,1990), Neutral Detergent Fiber and Acid Detergent Fiber (Van Soest,1991).

Blood collection: Three animals from each group of the entire study were selected randomly for blood collection. Blood collection of the selected calves was done three hours after the feeding. Ten ml of blood was collected from jugular vein and transferred to vacutainer. Serum was extracted by centrifuging it at 3500 rpm. Blood urea nitrogen (BUN) was analyzed according to the method by (Bull *et al*., 1991) and Blood glucose was determined by using crescent diagnostic glucose enzymatic colorimetric god-pap method (Trinder,1969).

Statistical analysis: The data thus collected for nutrient intake, digestibility, blood metabolites, growth performance were statistically analyzed using computer software SPSS 22 (Statistical Package for Social Sciences) and means were compared.

RESULTS AND DISCUSSION

Treatment of rice husk: The chemical analysis of treated and un-treated rice husk was carried out in the laboratory of this institute and are given below.

Table 2. Chemical composition of treated and un-treated rice husk.

Particulars	DM %	CP%	EE%	CF%	Mineral%	NDF%	ADF%	OM %
Treated rice husk	62.281	7.44	1.7	6.9	11.93	70.93	55.44	88.07
Un-treated rice husk	90.485	6.2	1.7	20	22.06	62	39.5	77.94

Treatment of rice husk with 2% NaOH reduced 50% Ash contents which is comprised of silica (sand) mostly. Similarly, NDF% and ADF% levels also improved in treated rice husk. Fiber contents of treated rice husk reduced three times as compared to un-treated rice husk. Protein contents of treated rice husk increased 20% and fat contents remained un-effected. Results of the present study are in accordance with the lab analysis of (Chun-Yang Yin, 2011) who reported that rice husk is composed of crude protein 5-6%, oil 8-12%, crude fiber 39-42%, ash 12 %. (Vadiveloo *et al*., 2009) studied the nutritional improvement of rice husks and he observed that in-vitro Digestibility (IVD) was larger by treating the husk with alkali treatment than all other treatments.

It is evident from the above results that with the increase in NaOH level for treating the rice husk, NDF, ADF, lignin and silica contents remained un-altered or reduced minimum at 4% level while it increased at optimal at 6% level. In contrast, Ash increased with the increase of NaOH level of treatment. It may be due to high alkali concentration may contribute to increase level of Ash contents and high level of Ash contents in the treated rice husk may reduce the digestibility which is a limiting factor for its utilization. Silica reduces the colonization of ruminal microflora and hence limits the palatability and the degradability of rice straw/husk in the rumen of animals. Hence, 2% level of NaOH was applied for the treatment of rice husk to be used in the formulation of different TMR for calf feeding.

Dry matter intake: Dry matter was provided to the animals from the TMR based diet containing treated rice husk with 2% NaOH and control ration contained 30% un-treated rice husk. 2Kg barseem fodder/animal were also offered daily to meet out the carotene contents and rumen fill effect. Comparing the results of group A and D fed on TMR containing 30% un-treated and treated rice husk respectively, DM intake was almost similar while group B and C fed on TMR containing 10% and 20% treated rice husk reduced their DM intake and growth apparently but statistically difference was non-significant. Mean values are given below.

Table 3. Effects of varying levels of treated/un-treated rice husk on DM intake, Growth and Feed Conversion Ratio.

Group	DM Intake/ group (Kg)	Avg. Growth (Kg)	Growth rate (Kg)	Feed conversion ratio (Kg)
Control group untreated rice husk	23.25 ± 2.858	54.8 ± 4.864	0.608 ± 0.054	8.58 ± 4.067
Test group containing 10% treated rice husk	22.92 ± 2.821	50.6 ± 4.475	0.56 ± 0.049	8.55 ± 3.355
Test group containing 20% treated rice husk	23.04 ± 2.704	52.8 ± 3.655	0.58± 0.040	7.61 ± 2.997
Test group containing 30% treated rice husk	22.30 ± 2.596	55.6 ± 4.331	0.61 ± 0.048	8.10 ± 3.515

Table showed that there is non-significant difference among the test groups and control group. Wanapat *et al.* (2009) reported significant results of dry matter intake and digestibility by using 2.2% calcium hydroxide treated rice straw in multiparous Holstein cows. (Singh and Gupta, 2012) presented similar results and found non-significant difference in Dry Matter intake of Karan Fries calves fed on 5.0% NaOH treated rice husk and wheat straw. This shows that alkali treatment did not affect intake. Saadullah *et al*. (1981) also reported that urea increased protein content as well as digestibility of rice straw. The results of higher feed intake are in agreement with the findings of many workers (Stone *et al*., 1966; Guggoldz *et al*., 1971) who reported higher feed intake in 25 NaOH treated rice straw wen fed to sheep. Our results are in line with (Vind, 1973) who reported higher feed intake in dairy cows fed 3-5% NaOH treated barley straw compared to untreated straw.

Growth Performance: There was no effect of alkali treatment in the growth pattern of the animals fed on control diet and test diets. The average values of growth during the trial in the animals of group A, B, C and D were 54.8 ± 4.864, 50.6 ± 4.475, 52.8 ± 3.655 and 55.6 ± 4.331Kg, respectively while average daily growth rate were 0.608 ± 0.054, 0.56 ± 0.049, 0.58± 0.040 and 0.61 ± 0.048 Kg with FCR 8.58 ± 4.067, 8.55 ± 3.355, 7.61 ± 2.997, 8.10 ± 3.515 Kg, respectively.

There was no significant difference in values of control group and test experimental group, $P < .05$. The main effect was not significant for Weight Gain, Total DM and FCR. Those *Nili Ravi* calves' who were fed on feed without and containing treated rice husk did not differ on reported amount of Weight Gain, Total DM and FCR.

Table showed that the animals fed on TMR containing untreated rice husk performed comparatively better in terms of growth rate while a difference was statistically non-significant in all groups of animals. This reveals that there is no effect of alkali treatment on rice husk on growth in animals. This may be due to some bitterness in diet containing alkali treated rice husk.

The results of present study are supported with that of (Singh and Gupta, 2012) who found similar results of growth and feed performance in crossbred male calves fed on alkali treated rice husk. Similar results were also reported by (Russel *et al*., 2011) to observed lower feed-to-gain ratio in steers fed on CaO treated stover silage than the control group (un treated stover silage).

Nutrient Digestibilities: Mean values of digestibilities of Dry Matter, Crude Protein, Ether Extract, Crude Fiber, Ash and Organic Matter in the animals fed on treated/un-treated rice husk based diet are summarized as below,

Table 5. Effect of varying level of treated/un-treated rice husk on nutrient digestibility.

PARTICULRS	DMD (%)	CPD (%)	EED (%)	CFD (%)	AshD(%)	OMD (%)
Control group untreated rice husk	77.60 ± 8.459	77.53 ± 10.14	78.83 ± 1.751	66.47 ± 18.29	70.84 ± 13.77	79.63 ± 6.226
Test group 10% treated rice husk	77.93 ± 3.394	77.83 ± 4.746	77.31 ± 4.690	67.22 ± 7.308	71.50 ± 10.12	77.12 ± 2.969
Test group 20% treated rice husk	78.44 ± 2.089	78.39 ± 6.991	74.27 ± 2.764	68.63 ± 9.264	71.70 ± 5.610	75.81 ± 1.447
Test group 30% treated rice husk	79.00 ± 7.619	78.82 ± 5.300	73.98 ± 11.07	62.42 ± 13.67	73.29 ± 8.979	77.97 ± 9.309

It is evident from the results of Nutrient Digestibilities of Ash, Dry Matter and Crude Protein increased with the increased level of NaOH treated rice husk based TMR diet, in contrast, Ether Extract and Organic Matter Digestibilities decreased with the increase in NaOH treated rice husk in the diet of experimental animals. While fiber digestibility decreased in the animals of D group fed on diet containing 30% treated rice husk and it increased simultaneously in the animals of group A, B and C. From the above narrated results, alkali treatment improved the digestibility of Ash, Crud Protein and Dry Matter positively but it effected the digestibility of Ether and Organic Matter but statistically differences were non-significant among the digestibility of nutrient in experimental animals.

Our results are partially in agreement with (Verma and Jaiswal, 1981) who studied the effect of NaOH treated wheat straw in Sahiwal steers and reported that crude fiber digestibility had significantly increased. (Lazai and Ptacek, 1975) also observed that rice straw with 85% DM had 46.9 and 36.6% crude protein and NFE digestibility increased, respectively. The improvement in the digestibility of crude fiber and crude protein due to sodium hydroxide treatment had been also reported by (Macanally, 1942). The results of (Rahman,1985) were partially disagree with the findings of present study who reported that non-significant increase in the digestibility of NFE when rice straw treated with NaOH. (Sewell *et al*, 2009) confirmed the benefits for nutrient digestion and subsequent growth

performance in lamb and steers when crop residues were thermo chemically processed. (Gong-Yuan *et al*., 2009) also reported that sulphuric acid treatments deformed the rice husk which enhanced the exposed more fiber to cellulases and thus digestibility increased.

Blood metabolites: Blood samples of two animals of each group were analyzed for blood urea nitrogen and blood glucose to see the nitrogen available in blood stream be used for recycling and energy available for microbial protein and volatile fatty acid synthesis in the body. This available ammonia nitrogen is recycled for the growth of fiber degrading bacteria, resulting in improving the fiber digestion. Mean values of both metabolites are summarized in the table.

Table 6. Effect of varying level of treated/un-treated rice husk on Blood Urea Nitrogen and Blood Glucose.

PARTICULARS	Blood Urea Nitrogen	Blood glucose
Control group untreated rice husk	43.83 ± 4.355	25.03 ± 2.800
Test group containing 10% treated rice husk	40.33 ± 7.659	23.47 ± 4.265
Test group containing 20% treated rice husk	40.83 ± 5.419	20.58 ± 4.237
Test group containing 30% treated rice husk	40.17 ± 7.859	22.28 ± 4.129

Apparently animals fed on diet containing untreated rice husk had higher level of blood urea nitrogen and blood glucose than all other test groups but statistically difference was non-significant. This showed that alkali treatment had no effect on the blood metabolites and they were unable to alter these values in the animals of test groups fed on diet containing un-treated/treated rice husk. It can be concluded that the animals of group A fed on diet containing untreated rice husk will recycle BUN and Blood glucose more efficiently and significantly. Various levels of dried citrus pulp included in the diets of buffalo calves had non-significant effect on blood metabolites. The findings of present study are in line with that of (Ahooei *et al*., 2011) who observed non-significant effect of dried citrus pulp on blood urea nitrogen in male fattening calves. Similar results were also found by (Belibasakis and Tsirgogianni, 1996) who found that diet containing dried citrus pulp had no effect on blood urea nitrogen in dairy cows. Results of present study are in accordance with (Oni *et al*., 2008) who found that different levels of dried citrus pulp had no effect of blood glucose in West African dwarf goats. (Broderick *et al*., 2002) observed similar results and found no effect of feeding dried citrus pulp based diet on blood glucose in cows.

Conclusion: On the basis of results narrated above, positive results in terms of growth, FCR and digestibility etc. are observed in the Niliravi growing calves fed on TMR based diet containing 2% alkali treated and un-treated rice husk.

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